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R. J. ELLING

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EXHALATION-VALVE UNIT FOR A BREATHING MASK

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Fig. 2.

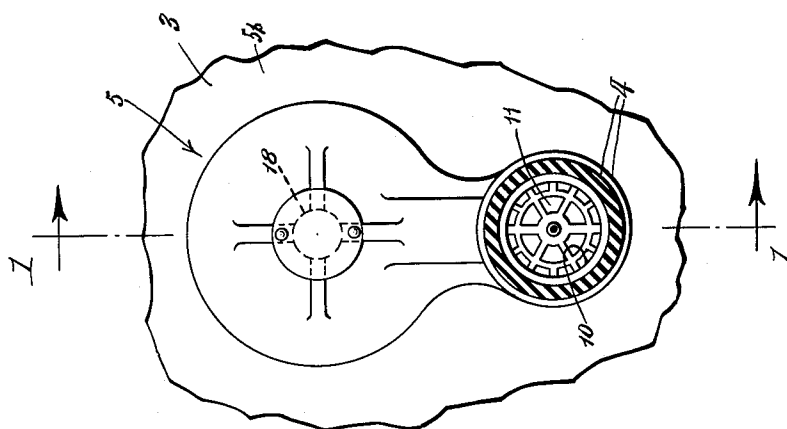
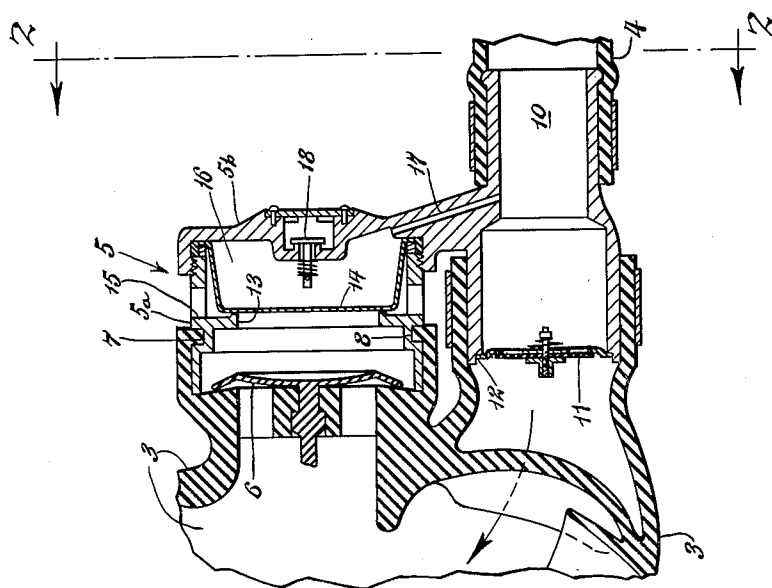


Fig. 1.



INVENTOR.
Richard J. Elling
BY
Walter H. Popp, Attorney.

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EXHALATION-VALVE UNIT FOR A BREATHING MASK

Richard J. Elling, Tonawanda, N.Y., assignor to
Scott Aviation Corporation, Lancaster, N.Y.

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6 Claims. (Cl. 128—142)

This invention relates to the exhalation valve unit for an ordinary, negative pressure breathing mask so as to enable said ordinary mask to carry internal pressures that are either lower or higher than the ambient pressures which surround the mask.

The principal object of the invention is to provide an exhalation-valve unit that will allow an ordinary, negative-pressure, breathing mask to be used as either a negative pressure mask or a positive-pressure mask with no loss of breathing fluid, except under emergency conditions. A collateral object of the invention is to provide an exhalation-valve unit of this character which will function properly even if the demand regulator, which supplies breathing fluid to the mask, is by-passed in an emergency. Other objects of the invention and practical solutions therefor are described in the following description and illustrated in the accompanying drawing, wherein:

Fig. 1 is a fragmentary vertical section thru the lower front portion of an ordinary, negative-pressure, demand type of breathing mask 3, showing my complete exhalation-valve unit applied thereto, taken on line 1—1, Fig. 2.

Fig. 2 is a fragmentary, transverse section thru the inlet tube 4 of said breathing mask, taken on line 2—2 Fig. 1.

This invention will be described, for convenience, exactly as is illustrated, but it is to be understood that the construction may be altered radically from that illustrated without departing from the intrinsic novelty of the invention or the scope of the appended claims.

It is preferred that the rubber mask 3 be of the full face type, but, as far as the present invention is concerned, it may be of either the oro-nasal type or the oral type. The mask is supplied with breathing fluid (such as compressed air or oxygen or a mixture of the two) thru the inlet tube 4. The supply of breathing fluid to said inlet tube 4 is provided by that type of demand regulator (not-shown) which is capable of supplying the required breathing fluid either under negative pressure (below ambient pressure) or under positive pressure (above ambient pressure) or, when an emergency condition exists, under a pressure very considerably above ambient pressure. This latter condition occurs when something wrong happens to the demand regulator and the operator opens the emergency valve of said demand regulator and thereby by-passes it entirely, in which case the breathing fluid under full supply-tank pressure passes into the inlet tube 4.

All of the components of the present invention consist of a casing 5 and the parts contained therein, said casing 5 being so constructed as to be capable of being applied to a breathing mask which was originally only used in combination with an ordinary, negative-pressure, demand regulator. Such an ordinary breathing mask requires just one standard exhalation valve which in the present invention we shall term the primary exhalation valve 6.

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It is obvious that, when only this one exhalation valve 6 is employed, it is impractical to supply breathing fluid under above-ambient pressures during the inhalation cycle, because such pressures would cause a flow of breathing fluid out of said exhalation valve 6 without being breathed at all.

The present invention avoids this waste of breathing fluid as to all ordinary, positive-pressure, breathing cycles by imposing a resistance to exhalation which increases as the pressures of the breathing fluid being supplied increases, i.e., as the pressure in the inlet tube 4 increases.

The casing 5 is provided at its upper rear end with an annular groove 7 which is adapted to receive an inwardly-facing, annular flange 8 that is formed integrally with the standard, rubber mask 3. The lower part of the casing 5 is formed to provide a breathing fluid, inlet duct 10 over the front end of which is clamped the downstream end of the rubber hose or inlet tube 4 aforementioned, it being understood that the other end of said inlet tube 4 is tubularly connected with a suitable three-phase, demand regulator (not shown). At the rear end of the inlet duct is arranged a check valve 11 whose metal periphery is suitably received within an annular rabbet 12 and is then firmly peened in place.

Forwardly of the primary exhalation valve 6, the casing 5 is formed to provide a circular valve hole 13 which acts as a valve seat for an impeding exhalation valve 14 which is made of laminated rubber and fabric, or the like, and is cup-shaped in form. The diameter of this impeding, exhalation valve 14 is greater than the diameter of the valve hole 13, and therefore said impeding valve 14 will close against exhalation flow even though the unit pressure on its downstream side is slightly less than the unit pressure on its upstream side. The front peripheral edge of said impeding, exhalation valve 14 is provided with a U shaped, dual flange which is suitably clamped between the two, threaded components 5a and 5b which constitute the casing 5.

All breathing fluid exhaled from the mask 3 must pass this impeding exhalation valve 14 and pass out through its exhalation ports 15 but whether it can pass said valve 14 at all, or to what extent it can pass depends on the pressure existing at the time in the impeding chamber 16. The latter is tubularly connected, through a small-diametered or restricted, impeding, balancing duct 17, with the breathing fluid, inlet duct 10. Hence the pressure in impeding chamber 16 always tends to be the same as the pressure in the inlet duct 10, but lags behind considerably if the pressure in said inlet duct 10 is considerably higher than that in the impeding chamber 16. This is because of the resistance of the impeding, balancing duct 17 resulting from its small diameter. When the pressure in the impeding chamber 16 becomes so high as to threaten to completely stop all exhalation, this pressure is kept within bounds by a spring-loaded, relief valve 18.

Operation

When the three-phase, demand regulator (not shown) which supplies the mask 3 with breathing fluid is set for negative (sub-ambient) pressures, the fluid pressure in inlet duct 10 is always sub-ambient (even on exhalation, due to check valve 11). This means that the cup-shaped, impeding, exhalation valve 14 is maintained under these circumstances in collapsed position, and is not able to oppose exhalation flow from the primary exhalation valve 6 out through outlet or exhalation ports 15.

When the aforesaid demand regulator (not shown) is so set (with its positive-pressure spring allowed to press on its diaphragm) as to put a positive (above ambient) pressure into the breathing-fluid, inlet duct 10, any wasteful escape of breathing fluid during inhalation is pre-

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vented by the impiedent, exhalation valve 14 whose resistance to exhalation is substantially proportional to the pressure in said inlet duct 10. This is of importance because different pressure regulators provide different amounts of positive pressure, and the present invention automatically adapts itself to whatever pressure regulator is being used.

In an emergency, the operator opens the emergency valve of the demand regulator (not shown) and this bypasses all the valves in said demand regulator and puts the full pressure of the supply tank onto the breathing fluid in inlet duct 10. Such an abnormally high pressure would, of course, rupture the impiedent, exhalation valve 14 if it were not compensated for, particularly if the supply tank was carrying its highest pressure.

The present invention avoids such a dilemma by restricting the flow thru the impiedent, balancing duct 17 (by having it small in diameter) and also by providing the relief valve 18 which permits of an outward flow of the breathing fluid from impiedent chamber 16 before the pressure in said chamber can become so high as to rupture the impiedent, exhalation valve 14.

I claim:

1. An exhalation valve unit in combination with a breathing mask, said breathing mask having a primary exhalation valve thereon, said exhalation valve unit comprising a breathing fluid inlet duct having an inlet check valve, an impiedent exhalation valve located in an impiedent chamber and a balancing duct tubularly connecting said inlet duct with said impiedent chamber, and means detachably interconnecting said exhalation valve unit to said mask so that said impiedent exhalation valve is arranged in series with said primary exhalation valve and

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downstream relatively thereto but mechanically functioning independently of said primary exhalation valve.

2. A device as in claim 1 with the balancing duct being of restricted diameter to prevent fluid surges in the impiedent chamber.

3. A device as in claim 1 with the impiedent chamber being provided with a relief valve to prevent such high pressures in said impiedent chamber as to prevent the impiedent valve from functioning.

4. A device as in claim 1 in which the mask with its primary exhalation valve constitutes an ordinary commercial breathing mask to which said exhalation valve unit is added to enable said breathing mask to be used when positive pressure is applied to said inlet duct.

5. A device as in claim 1 with the impiedent chamber being enclosed in a casing which is provided with an exhalation port which is adapted to receive exhaled air from the impiedent exhalation valve when the latter is pushed open.

6. A device as in claim 1 with the effective outer face of the impiedent exhalation valve having a greater area than the area of the valve seat upon which it is adapted to seat.

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